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FUEL FROM FORESTS

THE importance of forest fuel is apt to be out of focus in an industrial age where coal, oil and electricity occupy the foreground as sources of industrial power. It is worth while, therefore, to point out that while coal and oil are in the nature of fixed deposits drawn upon by man thereby inexorably diminishing the finite available stocks, fuel from the forest is in the nature of a current account which could continually be replenished; and, there is no reason why this account should not continue to run indefinitely, so long as man operates on it with prudence.

Wood was probably man's first fuel and fuel was probably man's first use of wood. Even to-day when wood has hundreds of other uses, it remains a fact that more wood is used as fuel than for all other purposes combined. Statistics relating to the annual consumption of wood in the world as a whole under various heads make interesting reading. Leloup, in a paper presented in 1949 to a Conference on the Conservation of Natural Resources, sponsored by the United Nations Organisation, made the following estimates:

Annual wood consumption in the world is 1,453 million cubic metres. This consumption is made up as follows:—

Fuel wood	825 million	57 per cent.
	cubic metres	of the total
Sawn Timber	360	25
Pulp	119	8
Industrial wood	149	10

While these figures relate to the world as a whole, the consumption of wood in the individual countries varies, naturally, enormously; but, it is fallacious to assume that industrially advanced countries do not make much use of wood as fuel. For example, in the United States where wood industries are highly advanced and where alternative sources of fuel are plentiful, fuel is even to-day the largest single use of wood. The American Forest Products Industries Organisation estimates the principal uses to which the annual American wood harvest goes as follows: fuel 42 per cent., lumber 34 per cent., pulpwood 13 per cent. and all other uses 11 per cent.

There is also another angle from which we can get a perspective and appreciation of

forest fuel. If we consider the energy resources of the world as a whole, excluding from this survey atomic energy, by far the greater part of these are in the form of coal, peat, petroleum, oil shale, natural gas, wood, vegetable and animal wastes, non-tidal water power, tidal power, wind power, terrestrial heat energy, solar energy, food and man power. Long as this list is, it is far from complete. We may confine ourselves for the present to man's use of solar energy which till our own day has been the traditional and by far the largest single source from which man has drawn.

The forms in which solar energy are available to man are best and simply expressed in terms of a basic unit being the energy equivalent of one million tons of coal. Employing this unit, Parker made the following estimates. The capital resources of energy—mainly in the form of fossil fuels such as coal and petroleum—are of the order of six million million tons of coal. The energy income, mainly in the form of wood, water-power and food, are equivalent to about 5,000 million tons of coal a year. Parker estimates the world's annual consumption of fuel and energy at about 3,000 million tons of coal.

As already mentioned, the world's annual consumption of wood fuel is estimated by United Nations experts at 825 million cubic metres; equating, approximately $1\frac{1}{2}$ cubic metres of wood to be one ton and taking five tons of wood to be equivalent to a ton of coal, this would mean that wood fuel contributes no less than the equivalent of 110 million tons of coal a year. Wood fuel is therefore significant even now in the fuel economy of the world.

Reference may be made here to another rather widely prevalent notion that since forest crops take time to mature, forest growth is a slow medium for the bottling up of solar energy. The facts are otherwise. It is true that as far as timber is concerned, a forest crop normally takes decades to be ready for harvest in contrast to an agricultural crop which often is an annual. But, if one puts into the balance sheet the entire organic matter produced by a forest crop during its normal life time, not excluding the litter produced year after year, and the root system below the ground, then, the figures make surprising reading. Ebermayer in Germany was amongst the pioneers to study this aspect of forest economy. He found that a normally stocked coniferous forest crop produces on an average about 4,000 kg. of dry organic substance per year per

acre. This figure is substantially more than the organic matter produced in two typical agricultural crops, viz., 2,000 kg. for hay and 1,500 kg. for beetroot per year per acre. Looking upon vegetation as merely a means of fixing carbon from the atmosphere into burnable carbon compounds, we thus see that a forest crop can be about twice as good as an agricultural crop. The 4,000 kg. of organic matter annually produced by an acre of forest would yield about 2,000 kg. of fixed carbon which on complete combustion should give 16 million kilocalories. This, then, is about the average amount of solar energy trapped by a forest crop per year per acre.

It is thus seen that contrary to appearances, forest crops are efficient converters of solar energy into usable fuel in the form of organic carbon and that wood is an important fuel even in highly industrialised countries.

The hydrolysis of wood into sugar has ushered in yet another technique by which wood is processed to cater to man's energy needs. And, according to present technique and practices in America, roughly 100 tons of wood yields about 35 tons of a 50 per cent. sugar solution. The product could be used as food for man, cattle feedstuffs or for fermentation to alcohol. The significance of the process lies in that the raw material, namely, wood residues are the waste product from wood working industries. Wood sugar thus opens up entirely new vistas of energy sources for use by man.

It is against this background of the importance of wood fuel that the inadequacy of our forest resources in India has to be assessed. International expert opinion prescribes 25 per cent. of the total area of the country as the safe minimum to be dedicated to forests. India has less than 20 per cent. The United States, Germany, France, the Scandinavian countries all have larger proportions; even Japan where the pressure on land of a much more industrialised people is acute has more than half her area under forest. In our country, the inadequacy of the total forest area is further aggravated by its uneven distribution adversely affecting our national economy in diverse ways. One of the most glaring examples and most pernicious in its effects is the misuse of cowdung as fuel instead of its rightful application as manure. This sets up a vicious circle which ultimately makes both food and fuel scarcer and dearer.

In South India, the absence of coal and oil has invested wood fuel with even greater importance. Wartime exploitation coupled with large increases in our urban populations have

compelled control, and sometimes even rationing, of wood fuel. The extent and urgency of the problem is best brought out with reference to figures relating to a typical urban area like Bangalore.

Bangalore with a population of about 700,000 might be reckoned to have 100,000 families. One family would need, confining strictly to domestic kitchen needs, about 2 cwts. of food fuel a month; even with this modest average, Bangalore needs 10,000 tons of wood fuel per month or 120,000 tons per year. Assuming the very high yield of 18-20 tons of fuel from an acre of forest, some 6,400 acres or 10 square miles of forest are needed to cover the annual fuel indent. And working on a short 30-year rotation, this means that 300 sq. miles of good forest are the minimum needed to ensure merely the domestic fuel indent of Bangalore alone on a none-too-liberal scale. This poses stupendous problems.

It is probable that these problems are solved not by any single cut and dry method. A many-sided approach is called for. Legislative measures might be considered for regulating the use of wood as industrial fuel. It is obviously not wise economy to feed the factory boiler while the domestic hearth remains unlit. Legislation might also be useful to discourage excessive fellings and to encourage afforestation.

Our domestic ovens may be redesigned to lessen dissipation of heat and also to burn waste material. Electric heating may be popularised. Coke may find acceptance in some of the areas. It may even be necessary in the over-all national interests, to gasify coal and lay down domestic supplies of heating gas in the larger cities. Last, but not least, and simultaneously with these measures, trees and more trees should be grown, the costs of their protection being drastically cut down with the active co-operation of enlightened public opinion.

India is said to abound in paradoxes. It is certainly odd that wood fuel—which is merely conserved solar energy—should be in short supply in this tropical country where the sun shines longer and brighter than in other less favoured climes. Some of the fastest growing forest species too are to be found in our country. We are therefore exceptionally well endowed by a kindly nature for the manufacture—if that term be permissible—of wood. The forest is the factory, and fuel one of the manufactured products. And, unless we grow more forests along with more food, the grim prospect of our having to import not only food but cooked food as well, is not as remote as some would have us believe.

M. N. RAMASWAMY.

LADY TATA MEMORIAL TRUST SCHOLARSHIPS AND GRANTS FOR 1952-53

THE Trustees of the Lady Tata Memorial Trust announce the following awards of Scholarships and Grants for the year 1952-53.

The International Awards of varying amounts (totalling £5,000) for research in diseases of the blood with special reference to Leucæmias are made to Doctors A. R. Gopal Ayengar (India), Pascou Atanasiu (France), J. B. G. Dausset (France), Astrid Fagraeus and Bo. Thorell (jointly) (Sweden), N. Harboe (Denmark), Charles Oberling (France), C. C. Ungley (England), J. Kieler (Denmark), C. Merskey

(South Africa), R. Rask-Neilsen (Denmark) and R. Robineaux (France).

Indian Scholarships of Rs. 250 per month each for one year for scientific investigations having a bearing on the alleviation of human suffering from disease are awarded to Messrs. Madhav Vinayak Patvardhan (Coonoor), Anant Vithal Sunthakar (Bombay), P. Venkateswarlu (Trivandrum), Rajaram Vasudeo Bhagwat (Bombay) and Doctors Jandhyala Sri Ram (Bangalore) and Purindra Nath Sen Gupta (Patna).

1851 EXHIBITION SCHOLARSHIP AWARD

THE Royal Commissioners for the Exhibition of 1851, London, have awarded an overseas scholarship for 1952 to Shri H. K. Jain,

Indian Agricultural Research Institute, New Delhi, for research in plant breeding at the University College of Wales, Aberystwyth.

RUSSIAN VIEWS ON PAULING'S THEORY OF RESONANCE

THE recent report of the Commission of the Institute of Organic Chemistry of the Academy of Sciences, U.S.S.R., on the present state of the theory of chemical structure contains many passages which vehemently attack the theory of resonance as propounded by Pauling. A critical reading of the whole report* shows that though the title of the report is 'The Present State of the Chemical Structural Theory' the real aim is to denounce the theory of resonance. This denunciation starts with a quotation from Lenin—"Reactionary aspirations are being bred by the progress of science itself. The wide advance of natural sciences, the approach of uniform and simple elements of matter, the laws of motion which can be mathematically treated produce the oblivion of matter by mathematicians. 'Matter disappears', equations alone remain. At this new stage of development, and in a quasi-novel fashion there reoccurs the old Kantian idea that the mind orders the laws of nature." The theory of resonance is quoted as an example of "physical" idealism and mathematical fetishism.

It is suggested that in this theory a concept of quantum mechanical resonance structures is created on the basis of a formal interpretation of one of the possible methods for the approximate calculation of molecules and further this concept is used for the explanation of facts of chemistry as though it existed as a physical phenomenon. To quote from the English translation of the report—"The wave function ψ (which describes the state of the molecule) is approximately represented by a sum, to each member of which is ascribed the meaning of a definite chemical structure. It is then asserted that the 'resonance' of these 'structures' causes the real state of the molecule. Thus 'resonance structures' and the resonance between them are the chief 'discovery' of the theory of resonance."

The following, in brief, are the points of criticism offered against the concept of the theory of resonance:

(i) This concept is connected with a particular mode of interpreting the separate wave functions, the linear combination of which serves as the approximate mathematical description of the state of the molecule. If other

approximate methods of calculation are used,† the concept of resonance does not arise at all.

(ii) Resonance structures are fictitious and the problem of isolating them is 'senseless'. Concepts of 'resonance structures' and their 'resonance' has neither experimental nor theoretical justification.

(iii) The notion of 'resonance energy' with its source in the 'quantum-mechanical resonance structures' is not valid. According to Pauling the deviation between the experimentally determined energy of formation and the corresponding energy calculated according to the additive scheme is identical with resonance energy. The deviations from additivity can obviously never be caused by the non-existent resonance structures.

(iv) The theory of resonance rests upon a methodologically false foundation. "Pauling and his followers substitute for the real molecule a collection of resonance structures, and for the actual factors which determine the properties of molecules a non-existent resonance between these structures."

(v) Followers of Pauling, particularly Wheland, hold idealistic Machian views. "They consider resonance to be a 'theoretical concept' and subsequently they establish the 'influence' of this resonance (i.e., of this concept) upon the properties of the molecules." This is an anti-scientific logic.

(vi) It is an idealistic concept and consistent use of this theory would lead to pseudo-scientific conclusions and produce the semblance of a 'scientific' explanation where essentially no explanation is given.

In the report it is mentioned—"It is regrettable that the faulty concepts of bourgeois science have also exerted an influence on Soviet scientists." Work of many Soviet scientists who have used this concept of the theory of resonance has been adversely criticised. In particular there is a very trenchant criticism of the book 'The Chemical Bond and the Structure of Molecules' by Ya. K. Syrkin and M. E. Dyatkina. The 'entire spirit of the book is permeated by ideas belonging to the theory of resonance'. It appears that this book was once prescribed as a text-book in chemical colleges. "In this way, it aided in spreading the perverse idealistic theory of re-

* An admirable English translation of the report has appeared in *Jour. Chem. Edu.*, 1952, 29, 2-13.

† Reference is made to Sokolov, N. D., *Uspekhi Khim.*, 1949, 18, 697.

sonance among workers in the field of chemistry."

The report also contains a directive for the Soviet scientists. "Soviet chemists and physicists should collaborate intensively to develop a theory of the mutual influence of the atoms in the molecule. Here special attention should be paid to uprooting the remnants of the influence of the resonance theory."

The aspect of the theory of resonance to which the Russians so violently object is essentially the following:‡

"From the foregoing discussion we see that resonance is a man-made concept in a more fundamental sense than most other physical theories. It does not correspond to any intrinsic property of the molecule itself,

but instead it is only a mathematical device, deliberately invented by the physicist or chemist for his own convenience."

In view of this, one cannot object to the great stress laid on the physical non-existence of resonance structures, but what is surprising is the vehemence with which the criticism is voiced and the manner in which it is linked with political ideology. It appears that after the Lysenko controversy the Soviet scientists are now busy in "uprooting" the theory of resonance.

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‡ Quotation from Wheland's *Theory of Resonance and Its Application to Organic Chemistry*.

SCIENCE AND ENGINEERING*

THERE have been few attempts to appraise with impartiality the liaison between science and engineering. On the one hand, the natural sciences have developed in the last quarter century a program of propaganda which, however essential in securing the support which research in science not only deserves but must have, has resulted in establishing in the popular mind the notion that engineering is merely a commercialisation of science—is, in fact, simply "applied science". Many people have assumed, therefore, that expanded research in science is all that is necessary to insure our continued technological and industrial supremacy. "The pure science of to-day," it is said, "becomes the applied science of to-morrow." On the other hand, engineers have been too busy "doing" to worry about what they regard as largely an "academic" question.

Probably the basic fallacy in this campaign of misunderstanding has been the statement, made and spread by many able scientists, that engineering is simply an outgrowth of and development from modern science, born of scientific research and still completely nourished by its parent. Important as the present liaison between science and engineering is, no more completely untruthful and dangerous statement could be made.

The case of Britain offers a striking example of the sterility of science alone as a prime factor in our industrial and economic life. From Faraday to Maxwell and Kelvin, from Darwin to Huxley and Tyndall, Britain had produced some of the greatest leaders in modern science. Yet, in the last fifty

years—years which have marked such an extraordinary era of material progress in the United States—Britain, the motherland of the Industrial Revolution, has been steadily declining in her industrial and economic position. If pre-eminence in science, as the propaganda of science so confidently proclaims, is all that is necessary to continued industrial leadership and technological progress, why has Britain fallen into what has been described as technological and industrial stagnation and decay?

It would be unrealistic indeed to ascribe this British decline solely to the high-hat attitude of British Science and the low estate to which engineering has fallen in Britain. To begin with, the British economy, based on the export of manufactured products and necessitating the import not only of basic materials but of essential food supplies, is clearly precarious and vulnerable to foreign competition. During the Victorian period when Britain almost stood alone industrially speaking, and ruled the waves, all was well. But, with the turn of the century, it became apparent that Britain no longer held an industrial export monopoly. The difficulty appears to have been that her industrial leaders did nothing about it. Adopting a self-satisfied, complacent attitude, she failed to follow up her earlier triumphs with continued developments and improvements—to realise that it is impossible to maintain a static position in a world based on technology and industry. Progress and change are not, as we have said, merely desirable—they are essential

* Abstract of an article by F. K. Finch, *Jour. Frank. Inst. Sci.*, 1952, 253, 201.

to survival. A stable, static economy is impossible—it is but the prelude to decline and decay.

This is not perhaps the place for an analysis of all the influences which have led to industrial and economic collapse in Britain. But certainly, one of the factors which has contributed to her unprogressive attitude has been the fact that science in Britain has succeeded in establishing the idea—as science in America seems latterly bent on doing—that engineering is merely cheap, applied science, and such applications can be left to those whose interests are vocational rather than professional and whose minds are directed solely to commercial pursuits—in short, given science, applications will take care of themselves.

Engineering is regarded as a "navvy", a laborer's pursuit in Britain—it is not a recognized profession. Engineering education is still largely a matter of rather narrow vocational technical school instruction—it is not a recognized university activity. There also appears to be a notion that the engineer deals only with science, with the materials and the forces of nature. The fact that his task is pro-

duction and that he must work with and direct men is ignored. Here is a washing of the hands of any connection with machine skills or engineered production, with the direction of labor. Here is a complete failure to realise that design is not an end in itself but merely a means to intelligent production.

The light has now begun to dawn, however, for, more recently, Sir Ewart Smith, in a paper reprinted in *The American Scientist*, clearly stated the truth, namely: "Any real basic knowledge which is evolved is broadly and relatively quickly available to all, and it is therefore upon technological skill in application that the progress of industry and, consequently, the economic position of the nation will mainly depend". Scientists not only do not possess this skill—there is every reason why it should not be one of their interests—but it would be a grave mistake if they should deny that the technique of application is, in itself, a subject of special knowledge, study and research. Indeed, it's what we do with knowledge—all available knowledge—that will determine a country's strength and progress. Science alone is not enough.

ARTIFICIAL COSMIC RAYS

IT is reported that the giant cosmotron at the Brookhaven National Laboratories, New York, is able to accelerate protons to energies of the order of 1360 million volts, which is more than three times greater than what has been possible till now. Also it appears that the range attained recently is only half that for which the machine has been designed. At full capacity it is expected to deliver atomic projectiles with energies of the order of 2,500 million volts.

By all standards, this must be considered as quite a remarkable achievement: for, as the energies associated with cosmic rays are almost of the same order as those produced by the cosmotron, this opens up the way to their being generated artificially in the laboratory, with a view to study their properties under controlled conditions—a feat considered as rather impossible till now.

INTERNATIONAL UNION FOR THE PROTECTION OF NATURE

MAN'S responsibility for the progressive formation, first of semi-arid regions, then of arid regions and finally of deserts being what it is, it is a pleasure to welcome the formation of an International Union for the Protection of Nature. We hope and trust that facilities will be made available to the Union in generous measure to enable it to fulfil the aims and objects set out in No. 2, Vol. 1 of its *Official*

Bulletin, viz., to examine critically the multifarious dangers with which nature is confronted consequent upon the constantly heavier pressure exerted by technicians upon biological cycles, to devise protective measures against wastage on the countryside, and to consider ways and means of extending the same over the widest area possible.

LETTERS TO THE EDITOR

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OBLIQUE INCIDENCE PULSE OBSERVATION OF THE IONOSPHERE NEAR THE MAXIMUM USABLE FREQUENCY

SOME time ago Appleton and Beynon¹ reported some signal intensity phenomena associated with continuous shortwave transmissions over a sender receiver distance of 1140 km., as the operating frequency approached, equalled and then exceeded the maximum usable frequency (m.u.f.) of the controlling layer of the ionosphere. Later Beynon² described both pulse and continuous wave experiments over a sender receiver distance of 715 km., but his experiments were mainly intended to discuss the Lorentz polarisation term in relation to

the ionosphere and to check the m.u.f. predictions made from the normal incidence (P', f) curves. No oblique incidence pulse observations seem to have been reported so far, in which the fading sequence reported by Appleton and Beynon¹ was studied. The present note describes results of observations made at Waltair on pulse transmissions from the All-India Radio Transmitter at Delhi, on a frequency of 21.7 Mc./s., over a sender-receiver distance of about 1,500 km. The pulses were radiated from 14.20 hrs. to 16.10 hrs. I.S.T., from the 20th February to 1st March 1952 and these were received on a communications receiver modified for pulse reception, the receiver output being displayed on an Oscillograph. Ionospheric data

show that during this period the pulses were received after a single reflection at the F_2 layer of the ionosphere and that the operating frequency was near the m.u.f. of the F_2 layer. Normally, therefore, only a single pulse was received and the amplitudes of the pulse were noted at intervals of 5 seconds.

A typical temporal variation of the pulse amplitude when the operating frequency was near the m.u.f. of the F_2 layer and the ionisation is decreasing is shown in Fig. 1 below. At the beginning of the transmissions

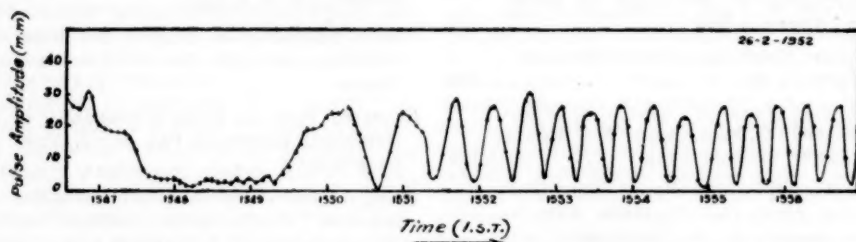


FIG. 1. Fading of pulse amplitude near m.u.f. Pulses from Delhi received at Waltair. Freq. 21.7 Mc/s Distance about 1,500 km. 26th February 1952.

the amplitude of the pulse varied slowly and in a random manner. During this time only the ordinary ray was received and the extraordinary ray suffered heavy absorption. After some time conditions were suitable for the reception of the extraordinary ray and the first signs of a periodic fading appeared at 15^h 46^m 48^s due to the interference between the two unresolved magnetotonic components. The frequency of the fading as seen from the figure to be 0.75 cycle per minute at the beginning and this increased to 6 cs./mt. at 15^h 56^m in about 10 minutes and remained almost constant thereafter. At 15^h 58^m 10^s another pulse of amplitude 2 mm. was received with a time delay of 0.5 millisecond corresponding to an optical path difference of 150 km. This is the so-called high angle or Pedersen ray. The separation between these pulses gradually decreased and finally they coalesced 10 minutes after appearance of the Pedersen ray, i.e., at 16^h 8^m giving a single pulse whose amplitude rose suddenly from 10 mm. to 31 mm. Just at this time the operating frequency corresponded to the ordinary ray m.u.f. of the F_2 layer. Soon the ordinary ray penetrated the F_2 layer and the pulse amplitude decreased to 5 mm. in about 5 seconds and remained almost steady in amplitude but for slight fading. At this time the extraordinary ray was still returned. The

extraordinary ray too penetrated the F_2 layer 20 seconds after the disappearance of the ordinary ray, i.e., 16^h 8^m 20^s.

The reported sequence is similar to the one reported by Appleton and Beynon¹ which was explained by these authors on the assumption of a parabolic region of the reflecting layer. The sudden increase in the signal amplitude which such an assumption predicts, when the operating frequency was equal to the m.u.f. was clearly observed as has been observed by Beynon² although Appleton and Beynon

could not observe this due to the overloading of their receiver.

A detailed account of the observations will be published shortly. The author wishes to express his thanks to the Director-General, All-India Radio, for co-operation in these studies and to Prof. K. R. Rao, for giving the necessary facilities.

Wireless Research Lab., Y. V. SOMAYAJULU.
Physics Dept., Andhra University,
Waltair,
March 6, 1952.

1. Appleton, E. V. and Beynon, W. J. G., *Proc. Phys. Soc.*, 1947, 59, 58. 2. Beynon, W. J. G., *Wireless Engineer*, 1948, 25, 322.

REFRACTIVITY OF NAPHTHALENE VAPOUR

A RAYLEIGH refractometer was constructed for measuring the refractive indices of vapours of crystalline solids, as it was felt that the data would be valuable in any discussion on the molecular theory of double refraction in crystals. The details of our investigation on naphthalene vapour are given here. The usual method of determining the refractivity of a vapour at a pressure actually measured by a manometer was not however adopted. On

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the other hand, advantage was taken of the availability of the saturated vapour pressure data at different temperatures in the International Critical Tables.

Sufficient amount of solid naphthalene was introduced into the refractometer tube which was evacuated and heated so as to saturate the space with the vapour. The side tube containing the solid was kept at a temperature 2° to 4° lower than the main tube through which light passed, in order to avoid condensation of naphthalene on the glass windows. Thus the pressure of the vapour inside was obviously the saturated vapour pressure at the temperature of the side tube.

The refractivity of the vapour was calculated by the formula

$$\mu - 1 = \frac{n \lambda}{l}$$

where l is the length of the tube, n is the number of fringes shifting and λ is the wave-length of light; and the refractivity was reduced to N.T.P. by means of the equation

$$\mu_0 - 1 = (\mu - 1)v,$$

where v is the ratio of the volume occupied by one gram-molecule of the vapour under experimental conditions, to the volume at N.T.P. ' v ' was calculated directly from the equation of state for the vapour. It was found that Van der Waal's equation and Berthelot's equation gave the same value for v ,* while the ideal gas equation $pv = T/273$, gave a value which was only very slightly higher (less than 0.1%) than this. The results are given in Table I. Mean refractivity of the vapour is thus

$$(3341 \pm 64) \times 10^{-6}.$$

TABLE I

No.	Temp. of the side tube °C.	Vapour pressure mm.	$(\mu - 1) \cdot 10^6$	$(\mu_0 - 1) \cdot 10^6$
1	66.1	2.88	10.71	3533
2	72.3	4.47	15.88	3466
3	75.7	5.75	19.10	3236
4	84.4	9.5	29.66	3129

The significance of the above result may be briefly discussed here. Ramanadham¹ calculated the principal polarisabilities of naphthalene molecule, applying the theory of anisotropy of polarisation field in liquids, and compared them with those deduced from the known refractive indices of the crystal. He subsequently revised the latter calculation utilising the data furnished by Sundararajan.² The revised

values are however unpublished, and they are given in Table II.

TABLE II

Principal polarisability	From anisotropic polarisation field theory ($\times 10^{24}$)	From refractive indices of the crystal ($\times 10^{24}$)
b_1	25.85	28.53
b_2	22.25	20.68
b_3	9.00	9.40

The values of the refractivity of the vapour, calculated from the data in columns 2 and 3 according to the equation

$$\frac{\mu - 1}{2\pi v} = \frac{b_1 + b_2 + b_3}{3}$$

are respectively 3217×10^{-6} and 3302×10^{-6} . The present experimental value 3341×10^{-6} is therefore in satisfactory agreement with that calculated from the refractive indices of the crystal.

The author is thankful to Sri. M. Ramanadham for his interest in this work.

Physics Department, S. VENKATARAMAN.
Presidency College,
Madras,
March 12, 1952.

* The constants for these equations for naphthalene were taken from *Landolt Bornstein Tables*, Vol. 1, p. 259, 1923.

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GEOMORPHOLOGICAL EVOLUTION OF DELHI AREA

THIS preliminary note deals with certain aspects of geomorphological features noted in Delhi State. North-South running belts of pre-Cambrian Alwar quartzites forming the Delhi ridge (800'-840') is flanked with two types of sediments—the eastern 'Khadar' on lower grounds (700') and the western 'Bhangar' on slightly higher grounds (700'-800'). The symmetrically folded quartzites were subjected to peneplanation by Tertiary times¹ and uplifted to form the present day flat topped ridges. North-south running valleys were initiated along lines of structural weakness, i.e., along anticlinal axis, so that we now get a parallel system of flattopped synclinal ridges intervened by anticlinal valleys, which latter are covered by Bhangar alluvium.

Intensive geological traverses and inspection of innumerable stone quarries show that there is only one rock-type in the area—the grey quartzites. Occurrences of tourmaline quartz veins are statistically insignificant. A number of soil profiles from Khadar and Bhangar areas were examined. Mineralogical analysis data of two typical soil profiles together with analysis of quartzites are given in Table I. These results show that the quartzites have not, in any way, given rise to these alluviums, which are quite rich in elements and minerals not found in the quartzites. The quartzites are characterised by blocky weathering, whereas the texture of Bhangar is uniformly silty sand² and that of Khadar varies between clay and coarse sand.³ Presence of abundant CaCO_3 concretions in the soils when contrasted with the absence of any lime-bearing mineral in the rocks is also confirmatory. Exposures of contact of alluvium and rock are frequently met in gully sections and are found to be very sharp, the rocks remaining quite unaltered.

The uniform silty texture throughout the profile, presence of considerable rounded grains below the critical limit of water rounding (0.03 mm.) and field characteristics suggest that the Bhangar alluvium is of aeolian origin.⁴ The texture is slightly coarse (median diameter (0.087 mm.) compared to that of typical loess (median diameter 0.017 to 0.037 mm.),⁵ but the degree of sorting as indicated by quartile deviation measure (0.67 ϕ), calculated from a mechanical analysis carried through Wentworth grades, is comparable with that of loess (0.34 ϕ to 1.49 ϕ).⁵ Relative coarseness of Bhangar

may be explained as due to the nearness of its probable source—the Rajputana Desert, whereas loess is generally deposited at a greater distance from its source—the Pleistocene glacial deposits.

The Khadar alluvium on the other hand, is a result of the sedimentation of the Jumna. Wide variations of texture from horizon to horizon, presence of horizons rich in certain detrital minerals like garnet and mica and practical absence of grain rounding stamp the sediment as of riverine origin.

Sedimentation was not continuous in the Bhangar area, there being several periods of rest which are marked by horizons of conglom-

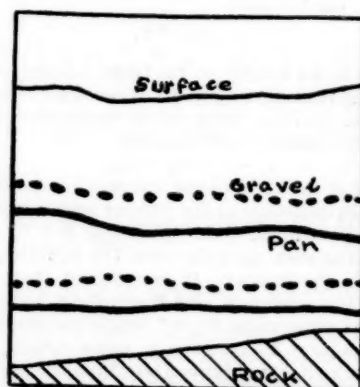


FIG. 1. Schematic cross-section of a gully face
Vertical height about 30 feet.

TABLE I
Showing the mineralogical analysis data of two soil profiles and the quartzite of Delhi

Locality	Escorts (Khadar)			Todapur (Bhangar)			Quartzite
Depth in inches	0-2"	9"-18"	48"-63"	0-9"	35"-40"	80"-90"	
Heavy % in fine sand	2.3	2.2	0.8	2.4	2.8	3.0	0.5
Ratio of quartz to feldspar in fine sand	n.d.	n.d.	n.d.	6	5	4	49
Mineral frequency in heavy fraction of fine sand							
Pyroxene	7	7	8	29	26	32	nil
Hornblende	35	23	15	25	27	23	tr
Epidote-zoisite	9	3	6	21	20	24	nil
Biotite	11	17	23	2	1	nil	3
Muscovite	12	20	19				33
Chlorite	1	2	7				1
Iron ores	9	4	tr	10	10	5	37
Iron oxides	5	5	5	4	1	5	tr
Garnet	5	10	9	8	11	6	tr
Tourmaline	2	2	1	1	1	2	22
Zircon	2	4	1	1	1	1	tr
Others	2	1	2	2	tr

merate, about 8" thick, persistently occurring in at least two levels. These periods of rest were of sufficient duration to allow pedogenic factors to operate, segregating CaCO_3 in both the levels of alluvium to develop a hard pan layer (Fig. 1). That these pans are not due to the present pedogenic activity is evidenced by the fact that overlying these "fossil" soils occur, at one exposure, about six feet of undisturbed lacustrine varve sediments at the rate of about 30 annual layers per foot, without any sign of vertical translocation of materials to indicate soil formation in the varves.

The alternations of the conglomerate, æolian and lacustrine sediments and the pan indicate a fluctuating history of aggradation and degradation punctuated with periods of rest. These fluctuations may be due to fluctuations in climate and/or crustal movements and are in continuation of the process which have given rise to the peneplaned Tertiary "quartzite" surface and the terraced nature of the Bhargar with respect to the graded flood plain of the Jumna Khadar. The Bhargar is now subjected to degradation as indicated by the young system of ravines in the area.

Studies relating to this problem of past climate and crustal fluctuations are being continued.

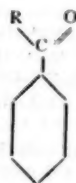
Chemistry Division,
Ind. Agri. Res. Inst.,
New Delhi-12,
February 19, 1952.

NARAYAN SEN.

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ABSORPTION SPECTRUM OF ACETOPHENONE

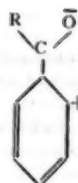
THE ultraviolet absorption spectrum of acetophenone was studied in ether solution by Kato and Someno,¹ in alcoholic solution by Grammaticakis² and in liquid and solid states by Deb.³ In this work the absorption spectrum of the vapour has been investigated and an interpretation has been suggested for various band heads. About 130 red degraded bands have been measured in the region ν 35235 to 39038. According to the resonance theory the aromatic carbonyl compounds are best represented as the combination of the classical structures I and quinonoid structures II and III.⁴



(I)



(II)



(III)

R = H or any alkyl group

The molecule can be classified as one belonging to the point group C_s . The observed band system can be attributed to the allowed transition $A' - A'$. The spectrum resembles that of pseudocumene⁵ (1 : 2 : 4-trimethyl benzene) which belongs to the same point group.

The (0, 0) band is located at ν 36394. Towards the red side of the (0, 0) band a large number of bands could be measured and among these the Raman frequencies⁶ 164, 615, 850, 950, 998, 1024, 1073 and 1157 could be identified. The band corresponding to Raman frequency 998 is very intense. The bands at distances 17, 28 and 59 cm^{-1} from (0, 0) band to the red side are interpreted as difference frequencies of 1-1 type transitions. Towards the violet side of the (0, 0) band the spectrum extends to λ 2560. From the positions of the band heads the following excited state frequencies are suggested:

ν 523, 745, 753, 938, 951, 1531.

A detailed discussion of the analysis will be published elsewhere.

Andhra University,
Waltair.
April 17, 1952.

G. VISWANATH.

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AGAVE VERA CRUZ—A SOURCE OF POLYFRUCTOSANS

AMONG some of the little known, indigenous sources of foods examined by us, one is the plant, *Agave vera cruz* (N.O. *Amaryllidaceae*; Hindi: *Rakaspatta*; Tamil: *Marakathalai*). Portions of the plant, it is known, are eaten by the poorer classes, especially under conditions of famine.

The succulent, surface underwood of the plant was the material used for investigation. Preliminary examination revealed that the carbohydrates, which form major portion of the soluble solids in the material, are a mixture of polyfructosans.

Inversion of the press juice (initial rotation ca. -20°) resulted in fructose* and a rotation (-74.6°) not parallel to fructose. There was no glucose in the hydrolysate, as determined by the method of Klein and Acree.¹ Nor did treatment with alcohol, acetone, neutral lead acetate or alumina cream help to obtain a homogeneous polyfructosan fraction.

TABLE I

Effect of treatment on the rotation of the press juice

Treatment	$[\alpha]_D^{25}$	
	Before inversion†	After inversion
Acetone: precipitate obtained dissolved in water	-20.7°	-75.8°
Lead acetate: filtrate delead	-19.3°	-76.8°
Alumina cream: filtrate	-20.8°	-74.7°

† From observed rotation and solids in solution.

On extraction of the dried and powdered material with methyl alcohol, two fractions resulted, one soluble, and the other insoluble, in that solvent. Working with a 2-lb. lot, soluble fraction amounted to 68% and the insoluble fraction to 32% (including fibre).

An aqueous solution of the fraction soluble in methyl alcohol was treated with 90% ethyl alcohol till complete precipitation: the precipitate was freed from alcohol and dissolved in water and the aqueous solution clarified with alumina cream and filtered. The optical rotation $[\alpha]_D^{25}$ was -29.31° , and increased to -77.85° on inversion. Aqueous extract of the fraction insoluble in methyl alcohol was filtered from fibre and the filtrate (colloidal and opalescent) treated with neutral lead-acetate and delead with Na_2CO_3 . The optical rotation $[\alpha]_D^{25}$ was -16.8° , and increased to -86.8° on inversion. Thus the methyl alcohol-soluble fraction, on hydrolysis, gave rise mainly to fructose, but the rotation of the hydrolysate was, again, lower than that due to fructose. On the other hand, the carbohydrates in the methyl alcohol, insoluble fraction, on hydrolysis, gave rise to fructose, with a rotation of -86.8° which allowing for concentration and temperature, is

in close agreement with the value for fructose (-91°).

In a modified experiment to obtain the methyl alcohol-soluble portion, 10 g. agave powder (dried at 100°) was refluxed successively with methyl alcohol (100 ml.) for 30 minutes in each case. The supernatant solution was decanted off before adding a fresh charge of methyl alcohol. The optical rotation of the successive fractions are shown in Table II. It was observed that with each charge of methyl alcohol, the solutes decreased, while the initial rotation progressively increased. This indicated that the portion grossly designated "methyl-alcohol soluble" is again a mixture of carbohydrates.

TABLE II

Rotation of the different fractions obtained with methyl alcohol

Extract	% Solutes	$[\alpha]_D^{25}$	
		Before inversion	After inversion
I & II	3.06	-23.44°	-74.49°
III & IV	1.39	-25.67°	-76.65°
V	0.51	-26.72°	-77.59°
VI & VII	0.76	-30.18°	-85.4°

Characteristics of the successive fractions obtained with methyl alcohol bear a close analogy to the carbohydrates present in Jerusalem artichoke. These carbohydrates, according to Thaysen, *et al.*,² consist of fractions with initial rotations -17.91° , -30.71° , -35.4° and after hydrolysis, -59.39° , -74.29° , -85.6° .

As polyfructosans have now been shown to be the main constituent of the edible portion of *Agave vera cruz*, there arises a doubt regarding the value of this material as food. In this context, the finding of Cremer and Lang³ that Jerusalem artichoke alone is poorly utilised in the system is significant.

The authors' thanks are due to Dr. V. Subrahmanyam, for suggesting the problem and for helpful criticisms.

Central Food Technological Res. Institute,
Mysore,
March 15, 1952.

M. SRINIVASAN.
V. R. BHALERAO.
N. SUBRAMANIAN.

* Estimated quantitatively by Lane and Eynon's volumetric procedure.

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A NEW RECORD FOR THE FOSSIL WOOD *GLUTOXYLON* FROM THE SOUTHERN PART OF WEST BENGAL

RECENTLY one of us¹ has reported on the form genus *Glutoxylon*. Since then we have received a fossil specimen of secondary wood from Mr. R. N. Chaudhuri, who collected it from the bed of the river Silabati, 7 miles from Garbeta Railway Station in the district of Midnapur, West Bengal. According to him, the specimen is 8 ft. long and 2½ ft. to 3 ft. in diameter and has been found embedded at a depth of 30 ft. from the surface. A piece 5 inches long and 2¼ inches in diameter has been sent to us. The Geological Survey of India gives the locality as "most probably Tertiary in age, possibly Late Tertiary".

The fossil wood shows a combination of two important anatomical characters, namely, the narrow bands of irregularly spaced apotracheal parenchyma cells some of which end abruptly (Fig. 1) and the horizontal gum ducts in the



Fig. 1.

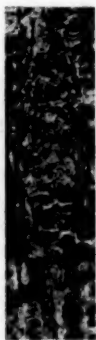


Fig. 2.

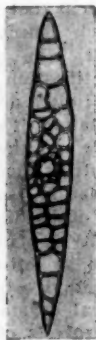


Fig. 3.

FIG. 1. Cross-section showing distribution of parenchyma cells and vessels.

FIGS. 2. & 3. Tangential section showing simple rays and a fusiform ray with gum duct.

fusiform rays (Figs. 2, 3). These anatomical features have led us to classify it under the genus *Glutoxylon*. On further comparison with *Glutoxylon burmense* (Holden) Chowdhury, it shows no difference in minute anatomical structure. The specimen from Garbeta is, therefore, named *Glutoxylon burmense* (Holden) Chowdhury.

According to previous records,² the western limit of the genus is the extreme east of Ranigunj Coalfield, from which the present locality, Garbeta, is about 60 miles towards south. The new find is of considerable interest in view of

the absence of *Gluta* in Bengal and of its present distribution in India.

The specimen bears Forest Research Institute fossil No. 74 and has been deposited in the Dehra Dun collection.

Our acknowledgements are due to the Director, Geological Survey of India, for information on the age of the locality.

Forest Research Institute, K. A. CHOWDHURY.

Dehra Dun,

K. N. TANDAN.

April 10, 1952.

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BIOGENESIS OF ASCORBIC ACID IN SPROUTING LEGUMES

ON the basis of observations that vitamin C formation is augmented in legume embryos grown in nutrient media containing glucose and mannose,¹ and that germination in the dark also results in stimulation of ascorbic acid formation along with increase in reducing sugars through enhanced amylolysis,² sugars have been suggested as active precursors of vitamin C. This has been demonstrated more directly with the rat, especially when chloretone-fed,^{3,4,5} adequate thiamine nutrition being a prerequisite in this case.⁶ Chloretone, however, is not utilised directly for vitamin C synthesis⁷ and presumably exerts its effect upon the enzyme systems which control the oxidation of glucose.⁸ Studies on the partial degradation of the biosynthetic ascorbic acid after administration of labelled glucose have provided evidence that the total transfer of C¹⁴ from glucose to ascorbic acid was approximately equivalent to total conversion of dietary carbohydrate to ascorbic acid by weight.⁷ The observations would suggest that the carbon chain of glucose may not be broken before being converted to ascorbic acid. However, the possibility of recombination of the fragments without a major dilution effect could not be ruled out and would seem the probable route from other observations⁹ on the stimulatory effects of glyceraldehyde and pyruvate in *in vitro* studies with liver slices of chloretonised rats. This is also inferable from the facts that chloretone administration to rats results in simultaneous increased urinary excretion of ascorbic and glucuronic acids^{3,4,5} and that glucuronic acid is formed from C₃ substances.¹⁰ Recent work from this laboratory would lend

support to the view that conversion of glucose to ascorbic acid takes place through mediation of the glycolytic route rather than through a direct oxidative pathway. Among the various observations made, using sprouted mung seeds or embryos therefrom, may be mentioned the following:

- (1) Vitamins of the B group, particularly thiamine, riboflavin and nicotinic acid, catalyse the oxidative breakdown steps that result in the formation of ascorbic acid from glucose.
- (2) The acids involved in the intermediary metabolism of glucose, particularly fumaric and succinic acids, stimulate biogenesis of vitamin C.
- (3) There is a close parallelism between the elaboration of ascorbic acid and of nicotinic acid under a variety of experimental conditions. The latter vitamin is partly found as pyridino-protein enzymes although on account of the high DPNase activity in seedling extracts they are not estimable in this form except when using nicotinamide during extraction.¹¹
- (4) Use of selective inhibitors of certain enzymes concerned in glucose breakdown, such as azide, iodoacetate and fluoride and in phosphorylation such as 2:4 dinitrophenol and atabrine, adversely affect ascorbic acid formation. The inhibitors similarly influence nicotinic acid, phosphatase and particularly pyrophosphatase activities.
- (5) Malonate, a competitive inhibitor of succinic dehydrogenase depresses ascorbic acid synthesis.
- (6) In proper concentrations, certain mitotoxic agents such as chloretone, urethane and coumarin favour vitamin C synthesis. This results presumably from a metabolic shunting of glucose intermediates away from the normal pathway and towards steps leading to ascorbic acid synthesis.

Details are being published elsewhere. One of us (S. P. B.) is grateful to the Lady Tata Memorial Trust for the award of a Research Fellowship.

Dept. of Chem. Technology, SMITA P. BHARANI.
University of Bombay, Y. S. SHAH.
March 29, 1952. A. SREENIVASAN.

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IDENTIFICATION OF ISO-OLEIC ACIDS PRESENT IN HYDROGENATED FATS BY PAPER CHROMATOGRAPHY

In an investigation on the nutritive value of hydrogenated vegetable oils, we have been interested in the determination of the content and nature of iso-oleic acids present in such fats. Apart from the analytical procedures (such as that of Cocks, Christian and Harding¹) which estimate the total content of iso-oleic acids, the only method available for the identification of individual isomers is that due to Hilditch and Vidyarthi² which involves the oxidation of a mixture of methyl esters of the acids and the subsequent identification of the resulting mono and dibasic acids. Though the oxidation itself is easily carried out, the isolation of the dibasic acids in an adequate state of purity is achieved only after a series of steps such as the conversion of the acids to their dimethyl esters, their fractionation and fractional crystallization of the free acids after hydrolysis of the esters. The physical and chemical characteristics of the acids thus isolated leave no doubt about their identity but the purity of the final samples, however, is seldom satisfactory. Also the quantitative interpretation of the results is rendered difficult since the pure samples of the acids isolated form only a very small percentage of the crude fraction. Begemann, et al.³ have effected a separation of the dibasic acids by adsorbing the mixture on a silica gel column followed by elution with a mixture of ethanol, methanol and water.

We have successfully employed the method of Reid and Lederer⁴ for the separation of dibasic acids formed on oxidation of mono-ethenoid fatty acids. These authors have found that malonic and succinic acids do not move up on the paper; but the lengthening of the carbon chain, presumably because of the greater partition coefficient of the acids between buta-

nol and water, results in a significant movement of the acids on the paper and hence the dibasic acids from pimelic acid upwards can be easily separated by this method. The acids show themselves as yellow spots on a purple background. The R_f values of a few of the acids are as given below:

Acid	R_f value
Pimelic	0.046
Suberic	0.085
Azelaic	0.14
Sebacic	0.20
Undecanedioic	0.31
Dodecanedioic	0.40

Calculated from chromatograms obtained from vanaspati

With the availability of this method for the separation and identification of dibasic acids, the identification of the various iso-oleic acids present in hydrogenated fat is rendered facile. The mixture of ethyl esters of the component fatty acids from hydrogenated fat is oxidized in acetone solution as described by Hilditch and Vidyarthi² and the dibasic acids separated from the monobasic acids by distillation in vacuum. The mixture of dibasic acids is applied as a spot to the paper in the form of its solution in dilute aqueous ammonia along with the spots of the ammonium salts of the pure acids and the chromatogram developed in the usual manner. The tracings from two such chromatograms obtained from a sample of "vanaspati" and from an iso-oleic acid fraction prepared from it by a method worked out in these Laboratories (to be published) are shown in Fig. 1. Spots in the diagram are due to

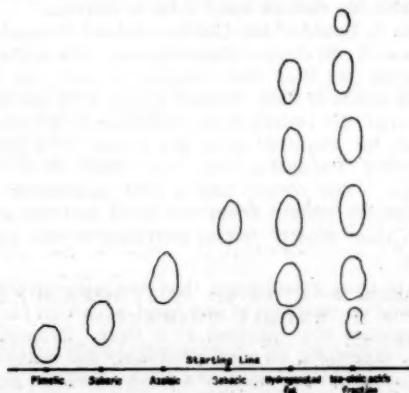


Fig. 1. Chromatographic separation of dibasic acids.

suberic, azelaic, sebacic, undecanedicarboxylic and dodecanedicarboxylic acids indicating the presence of Δ 8-, 9-, 10-, 11-, and 12-octadecenoic acids in the hydrogenated fat sample.

Quantitative aspects of this method are being studied and will be reported later.*

Nutrition Res. Laboratories, S. S. PHATAK.
Indian Council of A. P. MAHADEVAN.
Medical Research, V. N. PATWARDHAN.
Coonoor,
May 1, 1952.

* The above work is supported by a grant from the Council of Scientific and Industrial Research.

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SCHIZOTETRANYCHUS ANDROPOGONI HIRST, A PEST OF SUGARCANE

THE incidence of mites on sugarcane varieties in Bihar has been recorded by Khanna and Ramanathan, who have identified the mite as *Paratetranychus indicus* Hirst. The symptoms of attack described by them are identical with those noticed for the first time at Coimbatore on certain sugarcane varieties. The mites noticed at Coimbatore have been identified (by Baker of United States Department of Agriculture) as *Schizotetranychus andropogoni* Hirst. This is the first record of this pest in South India on sugarcane. Cherian has recorded it on the grass *Dicanthium annulatum*. Other alternate hosts noticed by the author at Coimbatore are *Erianthus fulvus* and *Miscanthus nepalensis*.

The attack is in the form of whitish oval patches on the underside of the leaves and very rarely on the upper surface of the leaf as well. The webs are thin and semi-transparent in the beginning and become whitish with age. The mite feeds on the leaf tissue by scraping the epidermis and sucking the juice. A badly affected leaf turns yellow and eventually dries up. Old leaves seem to have a preference over younger ones presumably because they are horizontally placed and hence afford protection to the under-surface. The patches often contain shrivelled eggs, reddish brown castings and cast off skins. The eggs are tiny, roundish structures, pale green in colour and look like beads. They are laid singly in linear rows inside the web at the rate of

6-15 or more per web. The mites are whitish or pale green and are seen moving about very actively. When a web is disturbed they are seen moving about in all directions but usually they return to the same web especially when the eggs are there. Sometimes they weave a new web at a different place. Two individuals take part in the weaving of a web each moving in the opposite direction in an oval form. Usually 10-15 individuals in various stages of development are seen inside a web.

Varietal differences are noticed as regards susceptibility or resistance to this pest. The presence of bristles and stomatal grooves in the lower epidermis have been noticed by Khanna and Ramanathan to be factors responsible for susceptibility of varieties. Attempts are being made to artificially infest a number of commercially important varieties, as also those used in breeding with a view to studying their resistance and work out a correlation with anatomical structure. Some of the varieties have taken up the infection and further work is in progress.

Thanks are due to Shri Nand Lal Dutt, for guidance. The author is indebted to Dr. E. W. Baker of United States Department of Agriculture, for kindly identifying the mite.

Sugarcane Breeding Inst., G. NARASIMHA RAO.
Lawley Road P.O.,
Coimbatore,
October 31, 1951.

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CONTROL OF MULLUSCAN FAUNA THROUGH THE CULTURE OF *PANGASIOUS PANGASIOUS* (HAMILTON)

MOLLUSCS are known to act as intermediate hosts for several helminth diseases of cattle and man, and in certain areas of India their large populations may be a source of great danger to livestock. Without affecting the biota of a natural or artificial piece of water, it is difficult to control them by the use of chemicals. Some measure of biological control would, therefore, seem highly desirable to keep down the population of molluscs.

Certain species of fish are known to feed on molluscs and a widely distributed, but not

very common species *Labeo calbasu* (Hamilton), popularly known as *Kalbasu* in Bengal, has been stated to include molluscs regularly in its menu. The fish that almost exclusively feeds on molluscs, where such food is available in abundance, is however, the Cat-fish, *Pangasius pangasius* (Hamilton). Mr. P. I. Chacko of the Directorate of Fisheries, Madras, found that in the months of June and July, this species predominates in the catches of the Mettur Reservoir and that the Gastropod molluscs of the genera *Melanoides* and *Indoplanorbis* "form the largest single item of food consumed by the species". In one of the specimens, Mr. Chacko found 400 shells, mostly *Melanoides* (*Tarebia*) *lineatus* (Gray). This specimen had been caught from the portion of the reservoir near the dam, late in the month of April. The shore of the reservoir in this portion is covered with rocks and stones where *Melanoides* are found in abundance. In the 3rd week of February this year, I found *Pangasius* fairly abundant in the catches of the Mettur Reservoir, but the specimens mostly came from the far end of the reservoir where the bottom and shore are mostly covered with mud. We found the species mostly feeding on *Vivipara* but were informed by local fishermen that bivalves are also eaten by them in large numbers during certain seasons. In a specimen, 28.2 inches in total length, 307 shells, mostly *Vivipara*, were found in the intestine. In another specimen, 25.2 inches in length, there were 288 shells. By weight also, the shells formed a very large proportion of the waste material. In a specimen 25.8 inches and weighing 6.75 lb., the viscera constituted 1.5 lb. In another specimen, 23.0 inches in length and 6 lb. in weight, the viscera was 1.5 lb. in weight.

Mr. A. David of the Central Inland Fisheries Research Station, Barrackpore (Calcutta), informs me that this species is cultured in some ponds of East Bengal along with species of carps. He recalls of an incidence at Khulna, when he inquired from the owner of a pond whether *Pangasius* was not destructive to carps. The owner had a few specimens of *Pangasius* caught from the pond and showed that they mostly fed on molluscs, in this case *Pila*.

It is thus established that *Pangasius* prefers to feed on molluscs of any kind, of which large quantities are ingested at a time. *Pangasius* can, therefore, be used profitably for cultural purposes where molluscs form a serious pest. It will not only control the growth of molluscs,

but will convert their bodies into a wholesome fish good and still permit their empty shells, which are expelled unharmed, to be used as grit for poultry.

A detailed account of the bionomics and possibilities of culture of *Pangasius pangasius* will appear elsewhere.

Zoological Survey of India,
Indian Museum,
Calcutta 13,
April 3, 1952.

S. L. HORA.

OCCURRENCE OF *ARENICOLA* IN BOMBAY

THE author discovered well-developed specimens of *Arenicola*, one of the polychaete annelids, in a muddy flat near Bombay. The largest specimen measured 20 cm. Reference to the Zoological Survey of India, Calcutta, revealed that *Arenicola* had not previously been recorded in any part of India and that its discovery in Bombay was of considerable significance.

The first complete account of the family Arenicolidae was given by Ashworth,¹ and its study has since been continued by many European authors. The distribution of the family Arenicolidae, as recorded by Ashworth (1904), is restricted more to the northern hemisphere above 40° North, only two species having been recorded in a zone slightly south of latitude 40°. The discovery of *Arenicola* in Bombay (Lat. 20° N.) thus extends its geographical distribution by 20° South of the previous records. A closer examination of the specimens found in Bombay shows that the species is new to science. The number of known species has thus been raised from nine to ten. A detailed taxonomic account of the new species is being worked out at the laboratory.

Taraporevala Marine
Biological Station,
Bombay 2,
April 25, 1952.

M. R. RANADE.

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REGENERATION OF FINS IN SOME AQUARIUM FISHES

THE complete regeneration of the caudal fin of a gold fish kept in an aquarium after it had been bitten off by another led us to carry out a series of experiments on regeneration of fins

in fishes. Most of the previous authors¹⁻¹¹ had concentrated on caudal fin, especially of freshwater species. In the present series of experiments, however, observations were conducted on regeneration of not only the caudal fin but also the pectoral, soft dorsal, anal and pelvic fins. The experiments were carried out on the following species of marine fishes: *Epinephelus diacanthus* (C. V.), *Pomadasys argyreus* (C. V.), *P. maculatus* (Bl.), *Lutjanus malabaricus* (Bl. Schn.), *Arius dussumieria* (C. V.), *Therapon jarbua* (Forsk.), *Pterois russellii* (Van Hass.) and *Balistis vetula* Linn. The selected species were all fully acclimatised.

It was observed that irrespective of the fin cut and the nature of the cut made, regeneration took place within five to eight and a half weeks, the exception being the adipose fin of *Arius dussumieria* (C. V.), which, when cut in various degrees, only healed up but did not regenerate. Regeneration time varied in different cases, the more anterior the cut made the longer being the time for complete regrowth. The strong spine of the pelvic fin of *Pomadasys maculatus* (Bl.) showed an arrested growth and remained as a blunt stump. Regeneration also took place when the fin was fully amputated. In *Therapon jarbua* (Forsk.) the amputated caudal fin grew into a normal fin while the fully amputated pectoral fin of *Lutjanus malabaricus* (Bl. Schn.) developed into a dwarfed abnormal fin.

In all cases the regenerated portion remained transparent for a time and pigmentation took place only at a later stage. Even after pigmentation was complete, the regenerated part could be distinguished for a long time.

Department of Marine
Biology and Fisheries,
University of Travancore,
Trivandrum,
January 29, 1952.

K. GOPINATH.
A. JOSEPH.

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ON THE FOOD AND FEEDING HABITS OF FIREFLIES

ALMOST no record is available of the feeding habits of Indian Fireflies, only a few foreign species having been studied and recorded.¹⁻⁶ McCann³ made observations on the feeding habits by keeping the glow-worm healthy for two years on a diet of landsnails. Parsons⁴ recorded *Lamphophorus nipalensis* feeding on slugs.

I have been able to ascertain some more interesting facts regarding the food and feeding habits in the Indian species, *Luciola gorhami*. The adults did not show any liking for plant food and even earthworms, crustaceans and other arthropods remained untouched. Lastly, slugs, landsnails and pondsnails with shell broken were given. A male was noticed on the body of a slug. The insect had made a strong grip by the mandibles and ejected out a slightly frothy dark coloured liquid which probably broke down the victim's tissue as now the whole head was immersed in the pulpy liquid and immediately after, the sucking of the tissue was observed under a binocular microscope, in a dim blue light. The blue light was observed to be the least disturbing one. When the insect moved from that place, it created a hollow space on the snail's body which measured 0.45 mm. broad and 0.2 mm. deep. Further, by sectioning and by dissections, it was revealed that the mandibles of the adults were not at all provided with any passage like that of its larva, through which the fluid might ooze out. The fluid was spit through the mouth and later sucked by closely aggregating the mouthparts. The suction was probably affected by the collapsible nature of the large hepatic cæcæ present at the end of crop. The specimen was immediately dissected and the dark liquid seen outside was also found in these cæcæ. The females were hardly seen to take any type of food.

The larvæ on the other hand are voracious feeders of small arthropods, crustaceans, worms, etc. A supply of different types of food showed that the molluscs do not form the main diet of the larvæ as has been reported by foreign workers on exotic species. It is interesting to note that I could study the complete life-cycle of the insect *Luciola gorhami* Ritz., by keeping the larvæ solely on a diet of earthworms. They also ate up the dead fireflies leaving behind the hard chitinous parts. The larvæ bore through the soil in search of their prey and remained under soil if their food resources get exhausted on the surface.

I am much indebted to Prof. S. Keshava, for technical guidance and to Dr. R. D. Saxena, for confirming my observations.

Zoology Department, P. N. SAXENA.
Science College, Patna University,
Patna,
December 14, 1951.

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BLOOM CHARACTER IN CASTOR OIL PLANT (*RICINUS COMMUNIS* LINN.)

VARIETIES of castor oil plant are distinguished by the presence or absence of bloom on the vegetative parts of the plant. Whereas only two types of bloom were described by Harland,¹ three have been defined by Patwardhan.² They are:—A. *Single bloom*: Presence of bloom on stem, petiole and peduncle. B. *Double bloom*: Presence of bloom on stem, petiole, peduncle and under-surface of leaf. C. *Treble bloom*: Presence of bloom on the aforesaid parts and also upper surface of leaf.

During the investigation of this character in 1947, at the Research Farm, Kanpur, the existence of other sub-types of bloom were discovered both in Class A and B. They were isolated and sown next year in different beds in order to determine their purity. All are breeding pure for noted characters. Harland has also mentioned that "in Class A one or more sub-types may be recognised, but so far no attention has been given to these."

The different classes of bloom noticed by us are given below:

1. Bloom on the peduncle and capsules only.
2. Very light bloom on the stem, petiole and inflorescence.
3. Single bloom.
4. Single bloom plus bloom on the prominent veins of under-surface of leaf.
5. Partial double bloom, i.e., bloom on the stem, petiole, peduncle and some portions of under-surface of leaf—the margins are left uncovered.
6. Double bloom.
7. Partial treble bloom, i.e., double bloom plus bloom on some portions of the upper surface of leaf—the margins remain uncovered.
8. Treble bloom.

The identification of the 4th, 5th and 7th classes of bloom can be easily made in young leaves of plants whereas in old leaves the bloom tends to become less and less heavy till it is completely obliterated. The genetical behaviour of some of these characters will be given later.

The author is grateful to Prof. K. N. Kaul, for help and guidance and to Dr. T. R. Mehta, for facilities provided at the Research Farm, Kanpur.

Land Reclamation Board, ANUBHAVA NARAIN.
Bhopal,
March 18, 1952.

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REVERSED POLARITY IN THE EMBRYO-SAC OF NAPOLEONA IMPERIALIS PAL. B.

AMONG Myrtiflorae, cases of reversed polarity in the embryo-sac were previously recorded in *Fuchsia marinka*,¹ *Woodfordia floribunda*,² *Lagerstrœmia indica*,³ *Oenothera gigas*⁴ and *O. Lamarckiana*.⁴

During the course of embryological studies in Lecythidaceae, the writer encountered a case of reversed polarity in the embryo-sac of *Napoleona imperialis*. In this species, an 8-nucleate embryo-sac is developed in an ovule, according to the normal type. Occasionally, however, ovules with two megaspores, two megaspore tetrads and two embryo-sacs also occur. The ovule sketched in Fig. 1 contains



FIG. 1. Reversed polarity in one of the two embryo-sacs. $\times 430$.

two embryo-sacs, one of them at the 2-nucleate stage and the other at the 8-nucleate stage. In

the latter, the antipodals (three in number) and a polar nucleus are situated at the micropylar end while the egg apparatus and the other polar nucleus are at the chalazal end. The two synergids can be distinguished by their pear-shaped form and the basally-situated vacuoles and the egg by its characteristic flask-shaped form and prominent vacuole in its upper part.

Andhra University, J. VENKATESWARLU.
Waltair, India,
March 21, 1952.

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WHITE NONSPORING MUTANTS OF PENICILLIUM NOTATUM CHRYSO- GENUM INDUCED BY RADIOACTIVITY

STAKMAN, DALY, GATTANI AND WAHL¹ have shown that addition of uranium nitrate to potato dextrose agar at the rate of 0.5-1.0 g./l. stimulated mutation in the cultivated mushroom, *Agaricus campestris*, and both mutation and an unusual type of dissociation in the ordinary corn smut fungus, *Ustilago zeae*. In *Agaricus campestris* the spawn of some mutant lines produced mushrooms of white colour instead of brown. They suggested that addition of uranium nitrate or other similar salts to nutrient media may be a simple and useful means of inducing desirable mutations in at least some micro-organisms. The agar containing uranium nitrate is mildly radio-active, as determined by Dr. Alexander Holmlander of the Oak Ridge National Laboratory, U.S.A.⁴ The investigation reported in this paper was undertaken to obtain some mutants of *Penicillium notatum chrysogenum* in an attempt to determine the biological significance and usefulness of the changes induced by radio-activity in that organism.

Monosporous cultures of strain 18 of *P. notatum chrysogenum* isolated from Indian soils by Gattani and Kaul¹ were used for these studies. For inducing mutations, the strain was at first grown on potato dextrose agar media containing 0.5 and 1.0 g. uranium nitrate/l. When growth commenced on these media, the actively growing mycelium was transferred to media containing 0.5, 1.0, 1.5 and 2.0 g. uranium nitrate/l. By the immediate transfer of the actively growing mycelium from media containing low concentrations of uranium nitrate to those containing high concentrations of ura-

nium nitrate the frequency of mutation as evinced by the production of morphologically distinct sectors, was enhanced greatly on media containing 1.0, 1.5 and 2.0 g. uranium nitrate/l. The fungus when transferred directly from potato dextrose agar to media containing 0.5 and 1.0 g. uranium nitrate/l. showed small sized colony with comparatively few sectors and on medium containing 1.5 g. uranium nitrate/l. growth of the fungus was inhibited completely.

More than fifty primary mutants were obtained from this strain and they were cultured on potato dextrose agar for one and a half months by making weekly transfers. During this period about twenty variants reverted to their parental type and were discarded. Of the remaining, 16 showed green sporing areas of different shades and 14 were mycelial in character and white in colour. From the white variants four designated as 18B, 18C, 18D and 18F were selected for detailed study.

The four white variants were purified by making single hyphal tip isolations and grown on Czapek agar along with parent strain 18. In strain 18 the colonies were velvety, plane with pistachio green to American green colour, with a biverticillate penicillus showing two divergent columns of spores. In 18B the colonies were white and spongy, in 18C white and flocculent, in 18D white, flocculent in the central portion and smooth else where and in 18F they were white and smooth. All white lines were mycelial, without any penicillus or spores.

Penicillin-producing ability of these lines was tested by the plug method as described by Raper, Alexander and Coghill², and by growing them in surface culture in liquid Czapek Dox medium. Assays were conducted according to the method suggested by Schmidt and Moyer.³ It was seen that the four white mutants were poor producers of penicillin than their parent.

White variants 18C and 18F during culture invariably gave green distinct sectors. Single spore isolations from these sectors produced green colonies with all the characters of *P. notatum chrysogenum* group. Two of such secondary green mutants 18C-1 and 18F-1 showed more penicillin production than their immediate white parents. However, the other two white variants did not produce any green variants.

It appears from these investigations that radioactive emissions from uranium nitrate promote the production of white, mycelial nonsporing mutants in strain 18 of *P. notatum*

chrysogenum. This asexual reproductive sterility may be partial as in 18C and 18F or complete as in 18B and 18D. When it is partial green mutants with all the characters of *Penicillium notatum chrysogenum* group are again produced from such lines. White, mycelial, nonsporing mutants produce less penicillin than their parent.

Dept. of Agriculture, M. L. GATTANI,
Rajasthan, Bharatpur,
March 25, 1952.

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NOTE ON THE CYTOLOGY OF *ATROPA ACUMINATA* ROYLE EX LINDLEY

From the medicinal standpoint, *Atropa belladonna* Linn., the source of Atropin, is one of the most important plants in the family Solanaceae. The other source of the same drug is *Atropa acuminata* Royle ex Lindley, called the Indian Belladonna. The leaves and other aerial parts as also roots of both plants may be used as source material. The vegetative parts of allied plants may be used as adulterants for these two which supply the true drug. As such, the anatomical studies of all these plants have been an important subject of research. Comparative anatomical studies of the two Belladonna plants have been worked out by Feinslein and Slama,³ George,⁴ Melville⁵ and Unger.⁶ The cytology of *A. belladonna* has been tackled by Vilmorin and Simonet.⁷ In this context a cytological study of the Indian plant was considered desirable.

Developing flower buds for meiotic studies were obtained from the nursery at the Lloyd Botanical Gardens, Darjeeling. Herbarium sheets were made from these same plants, from which later pollen were analysed. Seeds brought down to Calcutta would not germinate and so somatic plates could not be obtained. To all appearances the seeds remained viable for 1 to 2 months but radicles would not emerge.

It is here reported for the first time that the chromosome number of this species, similar to other members of this genus,^{2,7} is $2n = 72$. Although only meiotic counts have been made, the diploid number has been given here as

Pollen Analysis

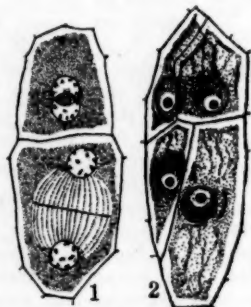
	Percentage of total	Average size	Size Range	Commonest size
Pollen with 3 germ pores	78.2	9.9 μ	8.2 μ -11 μ	9.9 μ
Pollen with 2 germ pores	20.7	6.7 μ	4.0 μ -8.2 μ	6.6 μ
Aborted grains	0

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OCCURRENCE OF FOUR KINDS OF MEGASPORE TETRAIDS IN *ELAEIS* *GUINEENSIS* JACQ.

Elaeis guineensis Jacq., the African Oil-Palm, has long been known as an important source of oil. It is a native of West tropical Africa and it is grown as an ornamental plant in the Law College Gardens, Poona.

During the course of an embryological study of this plant, some interesting variations were noticed in the arrangement of megaspores. The megaspore-mother cell divides transversely and forms a dyad of two cells. The next division in each of these dyad cells, however, occurs in different planes resulting in four kinds of tetrads. A linear tetrad is formed if both the dyad cells divide transversely. But commonly the micropylar dyad divides in a plane at right angles to that of the chalazal one and forms a T-shaped tetrad (Fig. 1). A case



of an inverted T-shaped tetrad was met with Fig. 1. Two cases were noticed where both the dyad cells divided in a plane parallel to the long axis of the ovule resulting in an isobilateral arrangement of megaspores (Fig. 2). The occurrence of different kinds of tetrads in the same species is of interest and a few such cases are cited by Maheshwari¹ (1950). The details of this investigation will appear elsewhere.

We are grateful to Prof. S. P. Agharkar for his kind and constant interest in our work.

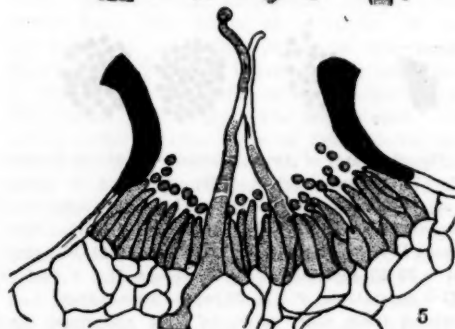
Botany Laboratory of M.A.C.S.,
Law College Buildings,
Poona 4,
March 28, 1952.

L. B. KAJALE.
S. G. RANADE.

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OCCURRENCE OF FLEXUOUS HYPHAE AND PYCNIOSPORE FUSIONS IN *SCOPELLA GENTILIS*

WHILE studying the life-history of the rust—*Scopella gentilis* (Syd.) Mundk. & Thirum. fusions of the flexuous hyphae with the pycniospores were observed in many cases (Figs. 1, 2, 3, 4 & 5). These resemble the "hypha-to-



FIGS. 1, 2, 3, and 4 showing fusions of pycniospores with the flexuous hyphae, $\times 1,700$.

FIG. 5, showing a T.S. of a pycnium with the complete length of the flexuous hypha which has also fused with a pycniospore, $\times 1,000$.

peg fusion" type described by Buller.¹ The hyphae, when projecting above the apical surface of the pycniosporophores, measure $45.5-64.5 \times 3.8-5 \mu$. The fusion papilla is not so narrow and constricted as was noted by Buller in *Puccinia graminis*. Only the apical ends of the hyphae fuse with the pycniospores, no cases of side branches developing from the hyphae being observed. In thin sections of the pycnia the continuity of the flexuous hyphae has been traced through the maze of pycniosporophores down to the palisade tissue

(Fig. 5). In this region they stain deeply with cotton-blue in Lactophenol, indicating the presence of rich cytoplasmic contents. Hyphae which have not fused with the pycniospores are not clearly visible even in thin sections below the pycniosporophores.

The pycnia and the flexuous hyphae of *Scopella gentilis* resemble very much those of *Phragmidium speciosum* and *P. potentillae*, as described by Buller,¹ except that the number of hyphae recorded by him in the latter two rusts varies from two to five. He has also enumerated the occurrence of flexuous hyphae in 51 species of the Uredinales, distributed in 8 genera of the Melampsoraceae, and 6 of the Pucciniaceae. The presence of flexuous hyphae observed in *Scopella gentilis* (Pucciniaceae) adds another instance to the list already known.

The writer is grateful to Prof. S. L. Ajrekar for his kind interest and encouragement, and to Dr. M. J. Thirumalachar for his valuable advice.

Botany Lab. of M.A.C.S., M. M. PAYAK.
Law College Buildings,
Poona, March 25, 1952.

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AERIAL TUBERISATION IN POTATO

THE occurrence of aerial tubers in potato as a result of disease and by removal of natural tubers, has been reported at the Agricultural Research Station, Colorado.² Apart from the presumption that aerial tuberisation is caused by interception of carbohydrates in its passage from the leaf to the storage region as a result of cankering and girdling on the underground part of the stem caused by disease,³ no experimental evidence, however, appears to have been adduced so far to locate the exact cause of aerial tuberisation. The following experiments were conducted to meet this end. Seed tubers of Great Scot were planted in pots on 14-9-50 and when the plants were 39 days old, various treatments were given to the several branches of a single plant keeping one or two branches as controls. The following treatments were replicated in three plants growing in separate pots under similar conditions of age and growth:

1. Ringed the stem partially to three-fourth of girth just above the junction of root and stem below ground removing the bark in the cut region entirely.

2. Ringed the stem fully just above the junction of root and stem below ground removing the bark entirely from the cut region.

3. The stem above ground and below first axil ringed fully removing the bark entirely from the cut region.

4. The stem above ground and first axil ringed fully removing the bark entirely from the cut region.

5. The bark and wood cut to half the thickness of stem at a point just above the junction of root and stem below ground.

6. The wood alone dismembered and bark cut to three-fourth of the girth at a point above the junction of stem and root below ground.

7. The main root just below the junction of stem and root dismembered, thus removing all the tuber-bearing stolons but keeping a few regular roots in tact.

After a lapse of 7 to 57 days from the time of operation in the different treatments, aerial tuber formation was observed to take place in different axils in different treatments.

A minimum period of 7 days for the appearance of tuber from the time of operation was noted in treatment 1 in which the treatment was given after 39 days from the time of planting. It may be noted here, that normal tuber formation is known to commence after 45 days from sprouting in Great Scot. In treatment 7 the region of the main stem around the 1st axil from the cut end was found to have slightly enlarged after 16 days from the date of operation. The tubers in treatments 1, 3, 4, 5 and 6 did not develop in size to anything more than a pinhead, whereas, in treatment 2 there was a steady increase in the size of tuber attaining a maximum thickness of 6 mm. at the end of 24 days from its first appearance. Thereafter it ceased to grow and the plant yellowed and died. The swelling of the stem noted in treatment 7 increased in size, finally assuming the shape of a regular underground tuber measuring 19 mm. in thickness. The tuber in the axil on the swollen stem developed, too, but much faster, growing eventually to a size of 25 mm. in thickness.

In treatments 1 and 5 the normal course of carbohydrates through the sieve tubes from the leaf to the underground stem gets partially intercepted, this, probably, resulting in an immediate stimulus being given to induce tuber formation in the axil just above the point of interception. In course of time, perhaps, in an attempt to restore the normal conditions of transportation of carbohydrates, a larger mea-

sure of the burden of translocation is thrown on the existing means of transport through the sieve tubes. This might offer an explanation for the not very appreciable size and rate of development of aerial tubers in these treatments. In treatment 2, the faster and larger development of the axillary tuber is evidently due to a complete interception of the carbohydrates from reaching the underground stem. The subsequent slowing down in the development of tuber in this and the withering of the plant shortly after might be due to the meagre supply of plant food reaching its root system. In treatment 7, on the other hand, the normal functional relationship is maintained between the root and the stem while the synthesised food from the leaf is not made available to the underground tuber-bearing stolons thus affording an unfettered scope for aerial tuber development in this case. This experimental observation indirectly confirms the observations made by Fitch² that the removal of the underground tubers results in aerial tuberisation.

Agric. Research Station,
Nanjanad, Nilgiris,
June 21, 1951.

P. UTTAMAN.

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CURARIFORM SUBSTANCES FROM ROOTS OF CISSAMPELOS PAREIRA LINN.

THE potent alkaloidal ingredients of curare, the well-known South American arrow-poison, have recently assumed increasing importance in medicine as muscle relaxants because of their neuromuscular blocking effect. These alkaloids are distributed among plants of several *Strychnos* species and several genera of *Menispermaceae*. Bhattacharji, et al.,¹ extracted an alkaloid—'hayatin'—from the root of *Cissampelos pareira* Linn., belonging to the genus *Menispermaceae*. The possibility of using this substance as muscle relaxant was explored. The present paper embodies the results of studies in the curariform properties of hayatin hydrochloride, methiodide and methochloride.

The curariform activity of the alkaloid was tested on anaesthetised (phenobarbitone) dogs whose gastrocnemius muscle was made to contract 12 times per minute in response to electrical stimulation of sciatic nerve. From the

depression of contraction caused by the substance, the curariform potency was assessed. While hayatin hydrochloride was found to have no effect on such preparation, hayatin methiodide and methochloride caused depression of contraction of gastrocnemius to a very great extent. Tested on the same preparations both hayatin methiodide (or methochloride) and d-tubocurarine chloride showed equal amount of curariform activity in the same doses. Denervated tibialis muscle from the same limb of the animal, while stimulated directly and simultaneously with the sciatic-gastrocnemius preparation showed slight depressant effect on the muscle contraction on administration of both hayatin methiodide and d-tubocurarine chloride proving that the substance acts by neuromuscular blockage. Like d-tubocurarine the curariform activity of the substance can be antagonised by prostigmin. Tested on rabbits, the head-drop dose for hayatin methiodide was found to be 0.110 mg./kg. (13 experiments), whereas the dose for d-tubocurarine chloride was found to be 0.14 mg./kg. (10 experiments).

Hayatin methiodide and methochloride produce a fall of blood pressure which is prevented by the antihistamine drug 'Phenergan' (Promethazine).

Hayatin methiodide in smaller doses at first depresses and then stimulates respiration both in frequency and amplitude and in higher doses paralyse it. No definite action has been found on intestine or uterus.

Depression of blood pressure following stimulation of vagus and contraction of nictitating membrane following stimulation of preganglionic fibres of superior cervical ganglion after administration of hayatin methiodide show that it has got no blocking effect on para-sympathetic or sympathetic ganglia.

Acute toxicity of the drug was tested on albino rats (80-120 gm.). LD₅₀ was calculated to be 0.31 mg./kg.

Hayatin methiodide (and methochloride) possesses almost an equal degree of curariform activity as compared with that of d-tubocurarine chloride but the fall of blood pressure, respiratory depression and autonomic blocking effect appear to be less marked. Further studies are in progress.

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K. S. VARADAN.

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REVIEWS

The Chemistry of Synthetic Dyes, Volume I.
By K. Venkataraman. (Published by Academic Press), 1951. Pp. xvi + 704. Price \$ 14.50.

The chemistry of synthetic dyes forms a large and important part of organic chemistry and most of the interesting earlier developments in synthetic organic chemistry have taken place from this branch. Besides its innate attractiveness, its relation to an important key industry accounts for its great progress and for its vastness. These features are brought out in the pages of the volume under review, which is the first of two volumes providing a comprehensive treatise on the subject. The treatment includes not only the chemistry of intermediates and dyes but also the application of dyes, the relation between colour and chemical constitution, the action of light on dyes and the chemical constitution of dyes in relation to their affinity for textile fibres.

The author is a well-known investigator and has made a large number of important contributions to this field. He has brought to bear on his task his experience of the past three decades as a researcher and as a teacher. He has travelled widely in Europe and America and has had excellent opportunities of obtaining first-hand information about the Dyestuffs Industry in Germany. All available sources of information have been used. The book however, is not a mere collection of all that has been said and written, but provides a balanced and critical account which is up to date.

The claim to comprehensiveness is fully justified by the contents of the first volume with 22 chapters. The introductory chapter gives not only a brief history, but also deals with 'Industrial Organisation', 'Chemical Engineering Aspects' and 'Names of Commercial Dyes'. The raw materials and intermediates are dealt with in the following three chapters. The salient features of the chemistry of each group (e.g., quinones) are briefly, but fully presented. Chapter VI on the application of Dyes is highly valuable. The theoretical discussion of colour and constitution covering about 80 pages is full and clear. Though the account has to be brief, just those details and items of general information are discerningly given that will enable the student to follow the

discussion without difficulty. The second half of the book deals with the dyes proper and gives a comprehensive account of azodyes and related groups.

The book is eminently readable and meets fully a real need not only of those specialising in the chemistry of synthetic dyestuffs, but also of the larger group working in organic chemistry, who will find it handy for reference on various occasions. The printing and get-up of the volume are excellent and it is remarkably free from errors.

T. R. S.

Prism and Lens Making. By F. Twyman. (Hilger and Watts Ltd., Hilger Division, 98 St. Pancras Way, London, N. W. 1). Price 5s 6d. Postage 1s. extra.

As the second edition of an earlier publication of 180 pages in 1942, the present volume has expanded to about 630 pages in 1952. This indicates the very considerable volume of new information not included in the first edition and not available in any other publication.

The use of Indian ink as a polishing medium for the final stages on glass or metal and the use of fine glass powder with which to finish the fine grinding of metal mirrors are typical of the new information published perhaps for the first time. Even so can be said to be the case of tests using the capillary rise of liquids for deciding the shape of flats being ground together when spherometer controls fail to indicate the departure from flatness in the last stages of the grinding. The publication of the data on a Fizeau Interferometer using a liquid surface as an absolute flat is most useful. This idea of Lord Rayleigh in 1893 was utilized by Waran for a parallel plate interferometer in the year 1919. So it is not as if the high degree of planarity provided by viscous liquid surfaces "has had surprisingly little application so far".

The first edition had left even advanced workers in doubt in many places. The enlarged second edition certainly overcomes this defect. No longer can it be said that a manufacturing firm cannot be expected to divulge in such publications all their processes and trade secrets. The firm of Hilger has reached such a high standard that by this publication they can be said to have thrown a challenge to the other

works to come out into the open with their methods for the ultimate benefit of science depending on quality optical instruments in many fields. What is really valuable stands protected by patents, e.g., the Twyman and Green Interferometers now used by all advanced manufacturers.

Though the war years 1914-18 and 1939-45 saw remarkable progress in the optical field when binoculars, range finders, and aerial cameras were needed in thousands, lone workers in the field have been feeling the lack of guiding literature in any quantity. This was perhaps responsible for Deve's "Optical Workshop Principles" a translation from French brought out as a Hilger publication in 1943. Beginners however will do well to start guided by a simpler publication like the monograph in optics "Spectacle Lenses" by P. Hariharan, an Indian publication of remarkable lucidity, the reason being that all optical processing appears so mysterious to the uninitiated. Even when assisted by such literature one will find on actual trial that many an experience has to be bought dearly only in the school of trial and error. Several pieces have to be worked patiently before confidence to turn out work of any quality and precision gets established. Then one will be tempted to agree with Twyman that no two glasses behave in the same way when the attempt is to produce regular surfaces of a precision reckoned in fractions of a wavelength of light. Each piece is a problem by itself, where one has to be satisfied by reaching a close approximation to the desired perfection. This is characteristic of the opticians' art as of all other arts.

A process worked out for quantity production in a large factory involving serious outlay on many machines, tools and accessories is at times almost incomprehensible and somewhat useless to the lone worker. He can manage many a precision job by the skill of his hand using but the simplest of mechanical accessories if he judiciously uses them with a scientific understanding of all the factors involved. Whenever stuck over a difficulty a reference to a standard text-book is often so illuminating and helpful as he can always pick up useful ideas discussed in the book. On this point this book is very helpful because of the wealth of data supplied as works' experience covering many aspects.

The book is by no means easy reading. There are difficult chapters like the one on interferometers likely to baffle one who has not got a daily acquaintance with costly interferometers. Even when so voluminous, it is not without its

omissions. Thus the measurement of aberrations by Foucault tests which lone workers like the reviewer find so useful in figuring large paraboloids for telescopes, finds no mention at all, though mention is made of the latest optical triumph the 200" telescope at Mt. Palomar. Excellent pictures of Newton, Foucault, Michelson, and Schimdt, who can be said to be the guiding spirits of the present-day optical art, add a personal charm all its own to this very useful technical book.

H. P.

Radio Astronomy. By B. Lowell and J. A. Clegg. (Chapman & Hall), 1952. Pp. 238. Price 16 sh.

This book is part of the newly started series of scientific publications, known as "Frontiers of Science", the aim of which is to "fill the gap between the very elementary expositions and the specialist text-books".

The subject of Radio Astronomy was born some twenty years ago, but it did not grow up until the post-war years. It owes its rapid development since 1945 mainly to the refined techniques in radio and radar evolved during the war. Many like the reviewer, who are not specialists in the field, would have only some vague ideas that radio waves have been detected from the sun and from regions of the galaxy and that radar echoes have been obtained from meteors and from the moon. It is fascinating to learn from this book that a vast amount of information has been obtained from such studies and that completely new avenues have been opened up for the exploration of the universe.

Meteors take up about one-third of the book. The main problem in this case is to decide whether they originate in the solar system or in interstellar space. Both the radiant as well as the velocity of the meteors are amenable to study by radar echoes. Although not absolutely conclusive, there seems to be very little doubt now that they do not come from outside the solar system. Incidentally, the radio method has revealed the existence of intense daylight showers which had escaped visual observation earlier.

The detection of radio emission from the sun of an intensity some million times that to be expected on the basis of thermal radiation has raised many interesting problems to be solved as regards their origin. It appears that there are regions in the sun, particularly near sunspots, where potential differences of the order of 10^8 V. exist. Radio waves are also being

emitted by the galaxy. This was detected as early as 1931, but the most exciting discovery is the one made by Bolton and Stanley in 1948 of the so-called "radio stars" in the region of Cygnus which has an angular diameter less than 8 minutes of arc and which is an extraordinarily intense source of radio waves. Several other radio stars have since been observed, but their explanation is far from clear because these regions are generally devoid of any outstanding visible objects.

A fascinating book, although not so elementary as the authors make it to be, it can be read with profit by anyone acquainted with fundamental physical concepts. The printing and get-up of the book are excellent, and considering its size and quality, the price is quite reasonable.

G. N. R.

The Sugar Industry—1950 Annual. Edited by M. P. Gandhi. (Gandhi & Co., Sir Pherozshah Mehta Road, Fort, Bombay), 1951. Pp. xvi + 156. Price Rs. 6 net.

The 1950 annual on the Indian Sugar Industry compiled and edited by one of our distinguished economists intimately connected with the Industry, constitutes one of the most authoritative sources of information on the scientific, industrial and economic aspects of the subject. The annual generally follows the plan analogous to that of previous issues. There are, however, a few helpful changes and additions made in the present volume. "Like the new sugar policy of the Government of India, we have also re-orientated this year the method of presentation of facts, statistics, and comments relating to the industry. Unlike our past *annuals*, the present one is divided into chapters, and detailed contents both of the matter as well as of tables have been provided to facilitate quick reference. Many tables on estimated valuation of sugarcane production, sugar consumption, *per capita* consumption and imports of sugar, cost of cultivation, etc., are provided. We have made new additions to World Sugar Industry statistics giving a comparative study. So also we have tried to give comprehensive information on sugar industry in different States in India and Pakistan, and on labour in the sugar industry as well as on labour legislation, etc." We have no doubt that this annual which has established a reputation for itself will receive the continued

patronage and attention of a large circle of readers interested in what is now regarded as one of the most important of our National Industries.

The Chemical Activities of Bacteria. By Ernest F. Gale. Third Edition. University Tutorial Press Ltd., London. (Oxford University Press, Madras-2), 1951. Pp. 213. Price Rs. 7-12-0.

The subject of the chemical activities of bacteria is a comparatively new discipline first conceived and pioneered by Majory Stephenson at the Cambridge School of Biochemistry under the inspiring guidance of Hopkins. The author, whose own contributions to this fascinating and fruitful field have been both brilliant and substantial, has rendered a great service to this rapidly developing subject by presenting this introductory treatise, which will not only prove useful to students of bacteriology and biochemistry but also inspire research workers to advanced effort in this field.

The author has taken advantage of the third edition to bring the volume up to date and revise the subject in the light of recent developments. For example, "during the last three or four years considerable advances have been made in our knowledge of synthetic systems and their control in the bacterial cell by genes". Elegantly got up and moderately priced, this volume will be widely accepted by bacteriologists and biochemists as an illuminating contribution to the subject.

Literature Review on Fats and Oils, 1949. (Published by the C.S.I.R., New Delhi), 1952. Pp. 32.

The review contains a summary of literature published in Indian and Foreign periodicals during the year 1949. Important aspects like production and technology of oils, hydrogenated oils and other edible fats, their nutritive value, keeping quality and methods of analysis have been dealt with in detail. The review should prove useful to all engaged in this wide field of perennial interest. The value of the publication would no doubt have been greatly enhanced if it had been brought out in good time like the well-known reviews on the same subject published by the Society of Chemical Industry and the American Oil Chemists' Association.

N. N. DASTUR.

SCIENCE NOTES AND NEWS

Psara phaeopteralis, Guen.-A Sugarcane seedling pest

Shri G. Narasimha Rao, Sugarcane Breeding Institute, Coimbatore, writes as follows:—

The occurrence of the Pyralid moth, *Psara phaeopteralis* Guen., in South India, was reported as early as 1926 by Cherian who recorded it as a pest of fodder grasses. During the past two years, it was observed that larvae of this Pyralid were destroying in large numbers young sugarcane seedlings grown in pans at this Institute. This is the first record of its damage to sugarcane seedlings. It is interesting to note that only seedlings well under 3-4 inches in height are ravaged, while the vigorous and taller seedlings are relatively free from their attack.

Suitability of Indian Glass Containers

With a view to examining the suitability or otherwise of Indian-made containers and analysing the causes of their shortcomings, the Central Glass and Ceramic Research Institute recently organised a discussion inviting representatives of glass, chemical, pharmaceutical, food preservation, toilet, cosmetic and other allied industries, also scientists and technologists, so as to bring together the producers and consumers of glass containers.

A Committee has since been formed with Dr. Atma Ram, Director, Central Glass and Ceramic Research Institute, as Chairman, and Messrs. K. N. Desai, S. P. Sen, M. L. Schroff, B. N. Maitra, B. Sircar, S. Ghosh, S. Niyogi, S. N. Ghosh, U. P. Basu, and Y. P. Varshney, as Members to work out ways and means of tackling this important problem.

Indo-U.S. Technical Co-operation for Fisheries Development

According to an operational agreement signed recently between the Government of India and U.S.A., more than a crore of Rupees will be made available by the latter for the expansion and modernisation of marine fisheries in India. The purpose of the project is to bring about an increase in the quantity of marine fishery products through improvements in the existing fishing crafts and methods of

capturing fish, discovery and exploitation of new fishing grounds in offshore waters, testing of the different types of crafts and gear not now in use but which are likely to be successful in Indian waters, training of Indian personnel in modern fishing methods and improvements in the methods of preservation and transportation of fish.

Kalinga Prize Award

The Kalinga International Annual Prize for the best work in the field of popularization of science, was awarded to Prince Louis de Broglie in a ceremony at Unesco House, Paris. Prince de Broglie is internationally famous both for research in theoretical physics (Nobel Prize, 1929) and for pioneer achievements in the popularization of science. He is the Honorary President of the French Association of Science Writers and the permanent Secretary of the French Academy of Sciences.

Indian Technical Assistance to S.E. Asian Countries

The Government of India have decided to offer, during the current year, 55 scholarships and fellowships to students from South and South-East Asian countries for training in India under the Technical Co-operation Scheme of the Colombo Plan. The scholarships, valued roughly at about Rs. 6 lakhs, are for training in degree and diploma courses as well as for post-graduate study and will continue for a period between two to four years, according to the curriculum chosen.

The training facilities would be provided in Indian Universities and in the specialised institutions in the country. The countries to which allocation for training facilities are being made include Burma, British Borneo, Ceylon, Indo-China, Indonesia, Malaya, Nepal, Pakistan, Philippines and Thailand.

Botanical Society of Bengal

At the Annual General Meeting of the Society held recently, the following Office-bearers were elected: *President*: Dr. J. C. Sen Gupta; *Vice-Presidents*: Dr. K. P. Biswas, Prof. P. C. Sarbadhikari *Hon. Secretary*: Dr. N. K. Sen.